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## Spectrum Isn't Like "Other Natural Resources"

By Thomas Kidd and Mark Rossow - [October-December 2010](#)

For the past 30 years the use of radio frequencies has dramatically increased. Radio has enabled the unprecedented growth of technology from cellular telephone to high speed wireless Internet. These and other capabilities we take for granted can only exist with the use of radio frequencies from the electromagnetic spectrum. However, a direct consequence from three decades of increased spectrum use is that spectrum availability, in many areas of the world, has declined to the point that spectrum is considered to be in short supply. The electromagnetic spectrum is generally regarded as a natural resource of the nation where it is used.

Spectrum has often been referred to as the "fuel" for wireless technology and the "oxygen" of the Internet. Spectrum differs greatly from natural resources, such as coal, land, water and air, because these resources are finite commodities; there is a limited amount of water, air, coal and land. Because they are finite resources, renewing them is either impossible or incredibly difficult. But the electromagnetic spectrum is not a finite commodity; it cannot be exhausted, and most importantly, the electromagnetic spectrum is instantly renewable. The moment that a radio, radar or some other spectrum-enabled device stops using a radio frequency, that radio frequency becomes instantly reusable by some other device. This simple, yet remarkable, difference means that efforts to manage and conserve the electromagnetic spectrum as if it were a natural resource, like water and land, are often misguided or ill-conceived. A resource that is instantly renewable cannot really be in short supply. As such, spectrum conservation is a misnomer.

The radio frequency spectrum includes all frequencies between 3 kilohertz (kHz) and 300 gigahertz (GHz). Except for the radio frequencies someone else is operating on at that precise moment, the entire electromagnetic spectrum is available for use 24/7. Curtailing or minimizing the use of spectrum to conserve it for future use may make conservation-minded people feel better, but it provides no preservation benefits whatsoever. Unlike natural resources that cannot be instantaneously recycled, spectrum is not physical; it cannot be saved for later use. The electromagnetic spectrum should be considered as an abstract resource.

Time is another abstract resource which cannot be stored and conserved. If time is not put to good use every moment, time is wasted. The same is true of the electromagnetic spectrum. Whenever spectrum is not used, it is a lost opportunity.

The U.S. radio frequency spectrum is allocated among federal and non-federal services, and use is governed by different organizations. The International Telecommunication Union, an agency of the United Nations, regulates information and communication technology issues. For nearly 145 years, the ITU has coordinated the shared global use of the radio spectrum, promoted international cooperation in assigning satellite orbits, worked to improve telecommunication infrastructure in the developing world and established worldwide standards. International spectrum governance involves the allocation of radio frequency bands for specific purposes and assigns radio frequencies for individual, commercial and government use.

This allocation and assignment strategy was conceived a century ago. Regrettably, this allocation and assignment policy restricts the efficient use of spectrum by limiting the use of a given radio frequency to a specific person, organization and/or purpose. Because the use is restricted, most radio frequencies are not used anywhere close to their full operational potential. Policy can be changed and with a new understanding of spectrum as an abstract resource, there is hope for future governance that permits the use of unused radio frequencies.

Understanding that spectrum is instantly renewable, that it can't be stored, and is being wasted every moment it is not used, the Department of the Navy is supporting emerging technology capable of using all available spectrum all the time. Technology under development known as cognitive radio systems will provide a dynamic spectrum access ability to identify and use unused radio frequencies. Cognitive radio systems capabilities will dramatically increase the effective and efficient use of radio frequencies by using more spectrum than is used today and simultaneously minimize the possibility of radio frequency interference.

As long as spectrum is defined as fuel for wireless technology, the oxygen of the Internet or prime real estate, it will likely be mismanaged as a finite resource. We are not running out of spectrum but,

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like time, spectrum that goes unused is wasted.

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Online ISSN 2154-1779; Print ISSN 1047-9988  
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